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Dr. William Quaide
National Aeronautics and Space Administration
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Final Technical Report for NASA Grant NAGW-1201,
Shapes of Uranus and its Satellites from Limb Coordinate Techniques
Principal Investigator: Dr. Peter C. Thomas

Dear Dr. Quaide:

This study expanded the techniques and applications of shape determination of satellites and planets using limb coordinates from Voyager images. The results established the sizes and shapes of all the large Uranian satellites with significant implications for the internal structures and tectonic histories of these objects. The results have been used for establishing the projection bases used by the US Geological Survey for maps of the Uranian satellites.

The major findings can be summarized as follows:

1. The inner large satellites of Uranus, Miranda and Ariel, are triaxial ellipsoids of shapes that are indicative of differentiated objects. Differentiation of satellites in this system constrains both the original rock/ice mixtures as well as thermal histories of the satellites.

2. Umbriel suffered very large impacts and volcanic resurfacing very early in its history but has retained much of the resulting topography.

3. Fault geometry on Titania constrains the thickness of its crust, and in effect constrains its likely differentiation.

4. The rigid outer crust of Miranda has at least two layered components as shown by fault geometry visible in the limb profiles.

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The following works were supported significantly by this grant:

Thomas, P. C. 1988, Radii, shapes, and topography of the satellites of Uranus, *Icarus 73*, 427-441.

Helfenstein, P., P. C. Thomas, and J. Veverka, 1989, Early resurfacing of Umbriel: Evidence from Voyager 2 photometry, *Nature 338*, 324-326.

Dermott, S. F. and P. C. Thomas 1990, Shapes masses, and interiors of satellites, *Adv. Space Res. 10*, 165-172.

Thomas, P. C. 1991. Internal structures and tectonics of Miranda and Ariel, for submission to *Icarus*.

Sincerely,

Peter C. Thomas

PCT:mr

cc: NASA, Headquarters/Contracts & Grants Div.
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